JET PROPULSION LABORATORY INTEROFFICE MEMORANDUM

August 21, 2003

IOM ECH0004-2003-20

TO: Eugene Burke

FROM: E. C. Hampton

SUBJECT: Genesis Optional One Year Backup Orbit Special Study

The Resource Analysis Team has performed a preliminary special study to evaluate the Genesis request for Deep Space Network (DSN) support for their backup orbit option from September 2004 through mid October 2005. The evaluation focuses on the support Genesis should expect to receive if the optional backup orbit is required and the effect Genesis requirements have on other project support and Deep Space Network (DSN) resources and activities. The preliminary findings in this study disclose problem areas in September, October, and November of 2004. The analysis reveals that September and mid-November of 2004 is projected be the most difficult period for Genesis support. The preliminary study results are based upon planning data used in preparation for the August 2003 Resource Allocation Review Board (RARB) and could be updated as soon as the database is updated with the approved recommendations from the August 2003 RARB.

Analysis was accomplished using the Forecasting and Scheduling Tool for Earth-based Resources (FASTER) forecasting system and the mission set database and data used for the August 2003 RARB. The analysis assumes the backup orbit will begin on DOY 252, September 8, 2004 and will end on DOY 287, October 14, 2005. The view periods used in this study were provided by the Genesis Project and are identified as GNS2 on the User Loading Profile (ULP).

Requirements

Optional Backup Orbit

September 8, 2004 Divert to backup Orbit
Continuous coverage from week 37, September 8 through week 46, November 14, 2004
48 hours of Continuous support for TCM coverage
One to four 4-hour passes per week for routine support

Table 1: Major Events for Genesis

EVENT	YEAR	WEEK	START DOY	END DOY
TCM	2004	38	262	263
TCM	2004	41-42	284	285
TCM	2004	44-45	305	306
TCM	2004	50	345	346
TCM	2005	04	026	027
TCM	2005	11	075	076
TCM	2005	15	103	104
TCM	2005	21	115	146
TCM	2005	25	173	174
TCM	2005	29	202	203
TCM	2005	32	223	224
TCM	2005	35	244	245
TCM	2005	38	262	263
TCM	2005	40	277	278
TCM	2005	41	285	286
Earth Return	2005	41	287	287

Throughout the backup orbit support phase, continuous and near continuous 34BWG1 support is requested from DSN stations for routine and TCM support. A User Loading Profile was provided by the project and support was requested in passes per week on the DSN 34BWG1 antennas. The Genesis view periods do not always allow for continuous coverage or coverage as specified on the provided ULP. Therefore, modifications were made to the ULP to maximize and distribute Genesis support in some weeks according to the provided view period. See attachment 1.

OBJECTIVES OF THE STUDY

1. To perform an assessment of user loading on the DSN 34BWG1 Subnet and to determine any impact on meeting ongoing mission tracking requirements in September 2004 through October 2005 if the Backup Orbit Option is exercised.
2. To determine the amount of support Genesis can expect to receive and the impact of this support on other users.
3. To identify significant and critical events and planned major antenna downtimes that will affect Genesis support and the network loading September 2004 through October 2005 time period.

CONSTRAINTS

1. Genesis, an S-band mission, can only be supported on the 34BWG1 Subnet.
2. Genesis view periods do not always allow for 8-hour passes at each antenna.
3. DSS-14 is approved for downtime from early July to late November 2004.
4. DSS-45 is approved for downtime from October 2004 through December 2004; therefore, placing a greater demand for DSS-34 antenna time.
5. DSS-43 is approved for downtime from late July to mid-September 2005.
6. DSS-54 is approved for one week of downtime from April 11, 2005 through April 17, 2005.
7. DSS-34 is approved for downtime from May 2, 2005 through June 25, 2005.
8. DSS-24 is approved for one week of downtime from June 27, 2005 through July 03, 2005.
9. DSS-65 is approved for downtime from February 2005 through April 2005.
10. Several launches and major events are scheduled to occur during this time period. See Tables 1 and 2 for a listing of the Major Events.

Initial Assessment

Genesis in 2004 should expect to receive from 60% to 75% of their requested support for weeks 37 and 38, 73% to 85% for weeks 41 through 46, and for weeks 47 through 53, 87% to 100% of their requested support. The projected supportable time in 2005 ranges from 92% to 100% until the last two weeks prior to Earth Return when the forecast is for about 80%. The addition of Genesis requirements during both periods studied caused an increase in 34BWG1 user unsupportable time in September. The weekly forecast of supportable hours for the Genesis Optional Backup Orbit in September 2004 through December 2004 is shown in figure 1 and the unsupportable time is shown in figure 2.

Detailed Assessment

Divert to Backup Orbit Option

The Divert to Backup Option support begins in week 37 on DOY 252 of 2004. Continuous and near continuous support is requested for weeks 37 through week 46, 2004. The Genesis view periods do not support continuous coverage in these weeks, as there are gaps between CDSCC and MDSCC as well as between MDSCC and GDSCC. The average unsupportable time for Genesis from September through December of 2004 range from 38 percent in week 37 to zero in weeks 47-49, 52 and week 53. See Figure 3. The period from September through mid November is projected to be the most difficult period for Genesis support. During this period, Lunar-A is in its LEOP phase, Mars Express Solar Corona, Stardust TCM, and Space Technology 5 is schedule to launch on November 19, 2004. These major events place an extra load on DSN resources. See Major Event listing, Tables 2 and 3.

The first period of the optional orbit is in contention for 34BWG1 support with Lunar A, Mars Express orbital science, ISTP SOHO, Polar, and Wind, Ulysses, and VGR 1 and 2. The projected unsupportable time is severe in week 37, and low to moderate in week 38 and weeks 41 through 46. This is due to DSS-14 and DSS-45 scheduled downtime

through week 47 causing the overflow of project support from DSS-14 and DSS-45 onto other antennas. DSS-34 is most likely to be overloaded due to the off-loading of supports from DSS-45 because of scheduled downtime. The projected unsupportable time in the remaining weeks, 47 through 53 is very low to none.

2005 Optional Backup Orbit

The projected unsupportable time for Genesis optional orbit support in 2005 is very low at this time. Although, DSS-65, DSS-54, DSS-34, and DSS-24 are scheduled for downtime from week 05, February, through week 27, July, and numerous major activities are scheduled to occur, they have little to no effect on Genesis request for support in 2005. The projected unsupportable time for the 34BWG1 Subnet per month range from 4 percent to 14 percent and the weekly projected unsupportable time range from 3 percent to a high of 20 percent. This projected 20 percent unsupportable time occurs in the last two weeks of the mission when Genesis view periods do not support continuous coverage, as there are gaps between CDSCC and MDSCC as well as between MDSCC and GDSCC. Genesis has contention with DSS maintenance, Mars Global Surveyor, Mars Express, and Voyager 1 and 2.

Summary

This support evaluation reviewed the Genesis Optional Backup Orbit support request for September 2004 through October 2005. Genesis is projected to receive 60 to 75 of their requested support in weeks, 37 and 38, in weeks 41 through 46, the projection is 73 to 85 percent, and all remaining weeks, 47-53, the projected supportable time range from 87 to 100 percent of their requested support for the divert to optional backup orbit.

Contention with other users of DSN 34BWG1 resources is moderate to severe in weeks 37, 38, 41, 44, and 46. Particular concern is noted during September, weeks 37 and 38, Lunar A launch and LEOP, October, weeks 41 through 44, Lunar A LEOP phase, Mars Express solar corona, and Stardust TCM, and weeks 45 through 48, November, ST5 launch and LEOP phase place an additional load on the DSN resources.

The projected supportable time for the 2005 optional backup orbit phase ranges from 92 percent to 100 percent. The Genesis optional backup orbit can be supported in 2005. However, the downtime at DSS-65, DSS-54, DSS-34, and DSS-24 and other DSN antennas may have an impact on the Genesis support when the actual schedule is generated.

This information is based upon data used for the preparation of the August 2003 RARB analyses and recommendations. As always, the results of this evaluation are preliminary in that the network load will change as requirements for planned missions are input and updated. Also, this information could be updated as soon as the database is updated with the August 2003 RARB approved recommendations.

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Resource Analysis Team

Supporting Data:

Major Events for 2004-2005

TABLE: 2 Major Events for 2004

PROJECT	2004 EVENTS
Cassini	**Probe target TCM** **Critical Sequence Uplink** **Probe Checkout and Release**
Deep Impact Flyby	**Launch December 30, 2004**
Genesis	**Earth Return August 2004** **Back-up Optional Orbit September 2004**
Lunar A	**Launch August 14, 2004** **LEOP phase**
Mars Express	**Solar Corona August – November 2004** **And Occultation in December**
Stardust	**Maneuvers in September and October 2004**
ST5	**Launch November 19, 2005 and Phase A and B** **November 22, 2004**
Voyager 1	MAGROL Maneuver DTR Array Playback ASCAL Maneuver
Voyager 2	MAGROL Maneuver DTR Playback ASCAL Maneuver
Wind TCM	**October 2004**
WMAP	**TCM November 2004**

Supporting Data continued

TABLE 3: Major Events for 2005

PROJECTS	2005 EVENTS
Cassini	Probe Release January 2005 Probe Entry January 2005 Saturn Tour January 2005
Deep Impact Flyby	LEOP, TCM
GSSR	Asteroid 1998WT March 2005
Hayabusa	TCM-2 January 2004 Rendezvous in March 2005
ISTP SOHO	HSO June 2005
Lunar A	LOI March 2005
Mars Express	Orbital Science January 2005
Mars Reconnaissance Orbi ter	Launch August 10, 2005
Rosetta	Earth Swingby February 2005
Stardust	TCM October 2005
WMAP	Maneuver March, July, and September 2005
STEREO Ahead	Launch November 2005
STEREO Behind	Launch November 2005
Wind	TCM January, April, July, and October 2004
Voyager 1	MAGROL Maneuver DTR Array Playback ASCAL Maneuver
Voyager 2	MAGROL Maneuver DTR Array Playback ASCAL Maneuver

Supporting Data continued

Figure 1: Requested hours per week for 2004

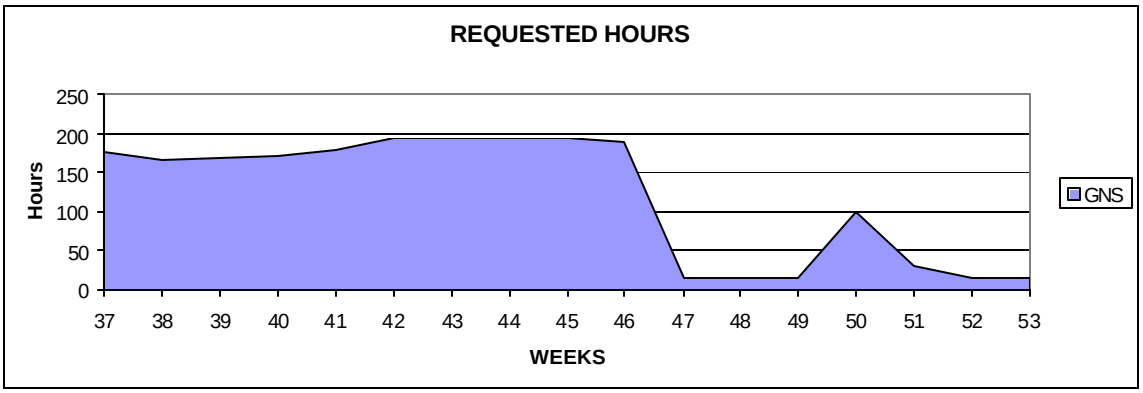

Figure 2: Unsupportable Time by hours for 2004

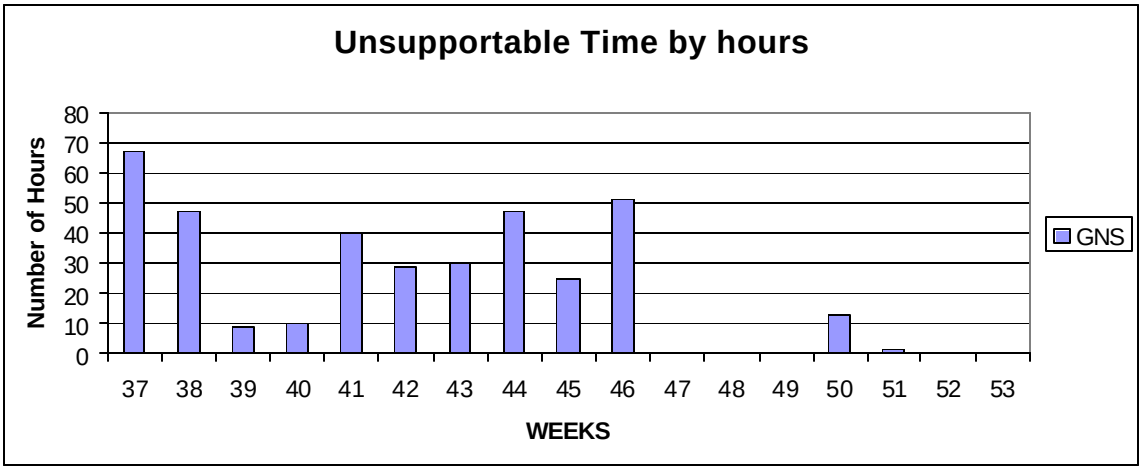

Figure 3: Percent of unsupportable time for 2004

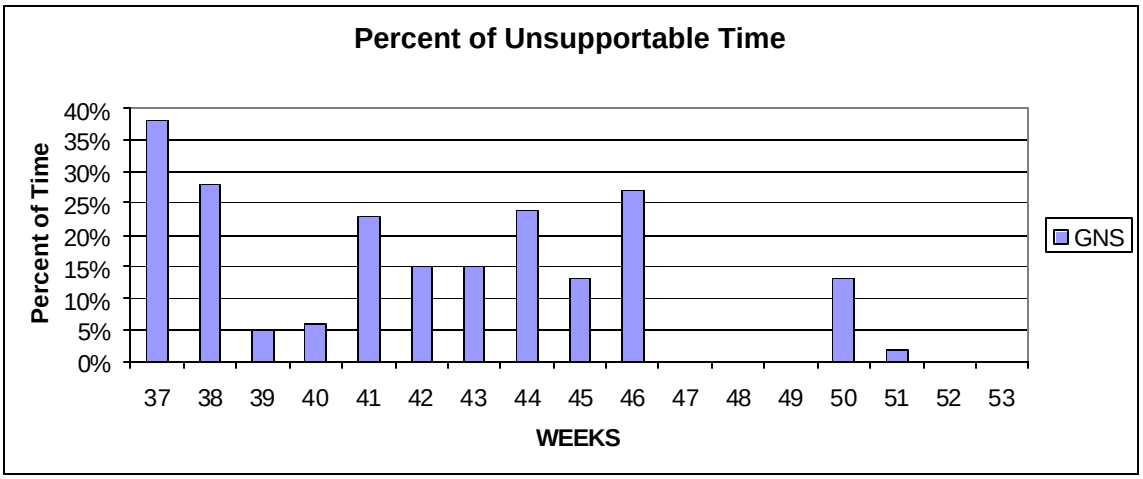

Figure 4: Requested Time by Hours for 2005

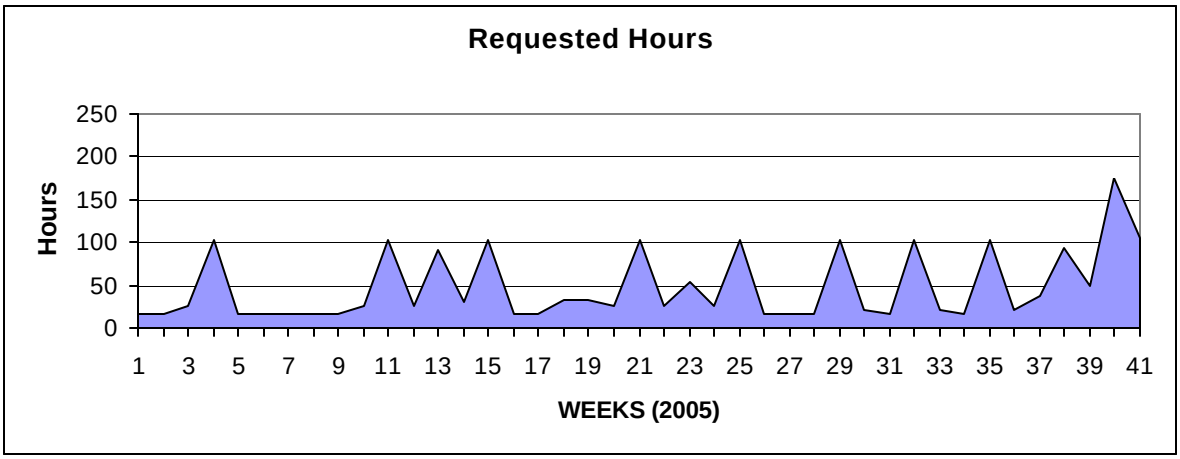

Figure 5: Unsupportable Time by Hours for 2005

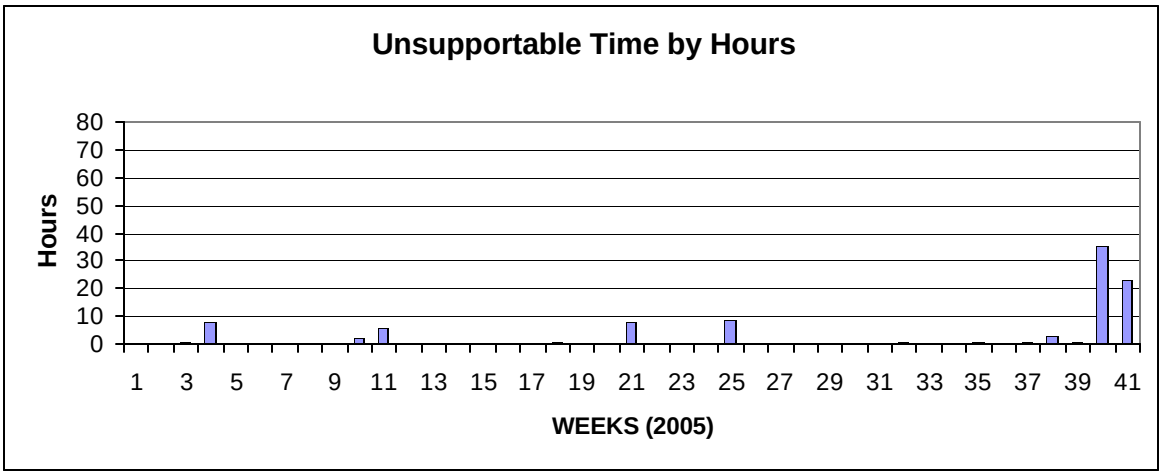

Figure 6: Percent of Time Unsupportable for 2005